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AUTHOR Brown, A.: And Others
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ABSTRACT

An investigation of the potential for computer-based instructional support (CBIS) for classroom support in the province of Alberta, this study identified three major CBIS applications which would relieve the teacher of some of the administrative workload associated with requirements to provide individualized student instruction: (1) accessibility of student records within a school, (2) province-wide accessibility of learning aid references, and (3) province-wide accessibility of a test item bank. The methods by which teachers could use a computer were examined in order to determine the technological characteristics necessary to support these applications. It was concluded that CBIS does have potential benefits, but that its implementation should be coordinated with other computer uses to ensure its cost effectiveness. Chapters discuss research and methodology, findings, the framework for CBIS, how teachers can access a computer, the scope and requirements of a practical CBIS system, technology requirements, feasible alternatives, recommendations, and a forward plan. References and summaries are provided. (FM)

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A PRACTICAL APPROACH TO

COMPUTER BASED INSTRUCTIONAL SUPPORT

A report submitted by: A. Brown
L. Anderson
D.A. Louth
of Currie, Coopers & Lybrand Ltd.

January, 1980

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ALBERTA EDUCATION
EXECUTIVE SUMMARY

Currie, Coopers & Lybrand Ltd. were engaged by Alberta Education to study the potential for Computer Based Instructional Support (CBIS) for classroom teachers. CBIS is intended to relieve the teacher of some of the increasing administrative workload associated with requirements to provide increasingly individualized student instruction.

Initial investigations revealed that little research had been performed in North America or the U.K. regarding such an application of computers. Further investigation, therefore, was conducted directly with classroom teachers. Selected teachers and principals were interviewed to determine a preliminary list of applications potentially appropriate for CBIS. This list was reviewed by our consultants and a questionnaire was constructed to solicit confirmation of, or amendment to, the list from teachers across the Province.

This process led to the identification of three major potential CBIS applications:

- Student Records accessible within a school,
- Learning aid references accessible Province-wide,
- A test item bank accessible Province-wide.

Other identified applications were either not suited to computerization or were not perceived as important to the teachers surveyed who responded, with surprising uniformity, to the questionnaire.

In order to determine the technological characteristics necessary to support the three main applications, the methods by which teachers could use a computer were examined. It was now possible to define CBIS more precisely, as follows:

> A system for Computer Based Instructional Support is for use by individual teachers at their discretion. It contains information banks which reduces the amount of teacher time involved in accessing information. The information is stored nearest the location where it is needed, subject to cost and organizational implications.

It was now possible to specify broad technological requirements for CBIS and to consider the available computer alternatives. Computer manufacturers were consulted to ensure that realistic options existed. In the attached report, three basic approaches to computerization are discussed: fully centralized, partially decentralized and fully decentralized. Although in practice we would expect that all three approaches would be used depending upon regional circumstances, the entry cost for CBIS is approximately $5 million for a relatively limited range of applications.

It must be realized, however, that the terms of reference for the study covered only one aspect of computer use in the educational process. Before a final decision can be made regarding CBIS, the results of this study need to be consolidated with other studies of computerization which ran concurrently with this one. These studies include Computer Assisted Instruction (CAI) and Computer Managed Instruction (CMI).

CAI, CMI and administrative uses virtually guarantee that the amount of computer power in schools, school boards and related organizations will increase. This being the case, it seems reasonable to guide this development so that the ability to implement CBIS is not excluded through the development of incompatible systems. Thus, it may well prove possible to obtain the benefits of CBIS at very reasonable incremental cost.

Our recommendation is that Alberta Education should:

- Examine the total requirements for computer power within all schools and school boards throughout the Province, as well as requirements which Alberta Education may have. This will provide the framework for planning the growth of computerization.

- Determine the current level and quality of computerization which already exists in these institutions. This provides the basis for determining what must be done to meet the identified overall requirements.

- Formulate a policy to guide the growth of computerization within educational institutions.

- Establish a pilot project within one school board. The pocket calculator illustrates how the benefits of new tools are often not recognized until they are available for use. A pilot study will provide this experience for CBIS. Costs can be kept down by selecting a school board with sufficient computer power already installed. Following the pilot study, costs and benefits should be reviewed and confirmed.

- Confirm the feasibility of CBIS and determine the level of computerization which must be achieved before it can be implemented.

In conclusion, the study revealed that potential benefits are possible with CBIS but that its implementation should be coordinated with other computer uses to ensure its cost effectiveness.

I. INTRODUCTION

Alberta Education is concerned with the increasing amount of time for non-teaching tasks being demanded of teachers of children between kindergarten and Grade 12. On August 22, 1978, Currie, Coopers & Lybrand Ltd. began a study to assist the Department in identifying where computer and communications technology could be used by teachers to alleviate their administrative workload, and then to outline a workable approach to achieving such a benefit. Details of our terms of reference were set out in our proposal of May 19, 1978 and are summarized in Appendix I to this report.

It is possible to conceive of many ways in which computers might help to alleviate teacher workload. For example, more routine topics could be taught directly by a computer as in computer assisted instruction; or new techniques for scheduling classes, such as the use of variable periods, could be devised to permit teachers to make better use of their time. A third example might be to have a bank of reference material which would reduce the time spent by teachers in preparing for classes. The first two examples illustrate environments within which the teacher is a somewhat passive participant, and separate studies are currently being carried out by the Department in these areas. In the third, however, a bank of information is established to be accessed whenever the teacher chooses, or not at all. Our task was to investigate the possibilities for applying computers to this third type of application, the set of such activities being called Computer Based Instructional Support (CBIS). In this respect, one of our initial tasks was to define CBIS because its consideration can very easily be allowed to overlap with computer assisted instruction, computer managed instruction or other uses of computers in education.

In order that our recommendations were practical, we followed a particular thought process which is reflected in the organization of this report. The logic of the report is as follows:

- Sections I to VI are concerned with determining the scope of a useful CBIS system, irrespective of technological or cost implications. In particular:

  - Section II reviews briefly our research activities;

  - Section III summarizes the findings which resulted from the research process. This determines the largest potential scope of CBIS;

  - Section IV restates the findings by emphasizing how information requirements are dispersed geographically. This deals with where data should be stored and how widely accessible it must be, and the impact on storage and communications requirements;

  - Section V considers whether teachers can realistically use all of the CBIS functions which have been identified in the preceding sections;

  - Section VI combines Sections IV and V to arrive at a functional definition of CBIS which is operationally feasible.

- Section VII describes the technological requirements of CBIS as defined above and considers the alternatives available, based upon discussions with computer manufacturers. The costs of these alternatives are also considered so that by the end of this section we will have discussed the operational, technological and economic feasibility of CBIS.

- Section VIII presents our recommendation and formulates a specific plan for further action to be taken by the Department.

Our overall guiding principle has been to identify CBIS applications which are capable of achieving real benefits in a cost effective way using today's proven technology.

II. RESEARCH AND METHODOLOGY

Although we intended to define CBIS during the study, we wanted the definition to arise in a natural way from needs rather than from an arbitrary statement. Accordingly, our approach aimed at finding out:

- How computers have already been applied to the education process;
- What requirements for computerized assistance arise from the demands made upon teachers;
- What limits exist regarding the use of computer assistance by teachers; and
- Can technology meet the identified requirements.

As a result of this approach, a definition of CBIS emerged which is technologically and operationally feasible. We then investigated the methods by which CBIS could be attained.

In this section, the tasks carried out by our consultants are described.

A. CURRENT PUBLISHED LITERATURE WAS REVIEWED

We began our study by attempting to identify and review related work already carried out by others in North America. Specifically, we sought either results which had been achieved or documentary evidence of failed experiments. Our sources included the ERIC computer system at Yale University which stores published and unpublished material on education, computer manufacturers, education research institutions in Canada and the United States, the files of Alberta Education and previous studies by our own firm. In addition, we asked our firm's office in London, England to check whether relevant studies had been conducted in the U.K. A list of major sources is attached as Appendix II.

B. SCHOOLS IN STRATHCONA COUNTY WERE VISITED

The Department arranged for our consultants to visit two schools in Strathcona County, which lies just outside Edmonton. The consultants carried out direct classroom observation, as well as interviews with two teachers and their principals. The classroom observation proved ineffective because the non-teaching tasks could not be observed or inferred during the teaching-learning process, but the teacher interviews provided far more promising results. The findings from this activity formed the basis for a questionnaire which was later sent to teachers throughout the Province.

C. FINDINGS WERE CONFIRMED WITH THE DEPARTMENT

The findings obtained from the above two steps were summarized and discussed with the Department. It was agreed that our literature search had exhausted the principal sources of useful information, and it was the collective view that our chances of

finding useful references from other more obscure sources were not probable. The literature search was therefore terminated. It was also agreed, however, that the school visits had yielded promising results that should be confirmed or expanded through a survey of teachers across the Province.

D. A QUESTIONNAIRE WAS DISTRIBUTED TO TEACHERS

Based on the findings already obtained, a questionnaire was devised to solicit opinions of a representative sample of teachers throughout the Province. The questionnaire was tested by asking the teachers in the two schools already visited to complete it. The questionnaire was then distributed to about 10% of the teachers in the Province by randomly selecting about 140 of the 1400 schools in the Province. Of about 2000 questionnaires distributed, 1029 or about half, were returned to us. The responses were keypunched and processed through a computer for analysis. A copy of the questionnaire is attached as Appendix III.

E. FINDINGS WERE CONFIRMED AND IMPLICATIONS ASSESSED

By relating the questionnaire responses to our original findings, we were able to confirm where computers might beneficially be applied, and hence to determine applications appropriate for CBIS. Our next step was to assess their technological feasibility.

F. DISCUSSIONS WERE HELD WITH REPRESENTATIVES OF THE COMPUTER INDUSTRY

We held interviews with two major computer manufacturers, Sperry Univac and NCR, in order to assess how the feasible approaches to CBIS might be obtained, and the practical limits

to current technology. IBM were also invited to discuss CBIS but did not respond to our invitation in time for issuing this report.

G. THE BEST APPROACH TO CBIS WAS CHOSEN

From all of the factors identified, it is possible to determine the most practical approach to CBIS which is also capable of maximizing the associated benefits. Because of the emphasis on practicality, this also defines CBIS with some precision, and identifies the conditions necessary for its success.

H. A FORWARD PLAN WAS CONSTRUCTED

Our study examined one possible use of computers within the education process. Before the Department can select a particular approach to CBIS, the possible effects on other computer uses and the organizational implications of the alternatives for CBIS must be considered. Our last step was to consider these aspects and construct a plan for the Department to follow.

Underlying all of these particular activities, our basic premise is that an effective CBIS system will be achieved only if it is perceived by teachers to be of value and is easier to apply than whatever methods they may now be using. These can be considered as fundamental conditions for the success of any proposed CBIS system, and they have been kept in mind constantly throughout our investigation.

III. FINDINGS

There are essentially two classes of findings to report. Through the literature search we sought results relevant to our study which had already been obtained; whereas from teacher interviews and the questionnaire we wished to identify further opportunities for CBIS.

A. CBIS DOES NOT APPEAR TO HAVE BEEN STUDIED OR ATTEMPTED TO ANY SIGNIFICANT EXTENT

An extensive review of literature was carried out, as well as telephone interviews with representatives of educational institutions and computer manufacturers in North America. Enquiries were also made in the U.K. Few tangible results were discovered. Computers are in use in education in Ontario and British Columbia and in Detroit, Michigan, but not in ways that relate directly to Computer Based Instructional Support for individual teachers. The primary use of computers in education below university level appears still to be for computer assisted instruction and general accounting. Some individual applications were discussed in the literature but these were isolated instances which bear little relation to a Province-wide CBIS system. These are listed in Appendix IV.

B. SOME NON-TEACHING TASKS LEND THEMSELVES TO COMPUTER ASSISTANCE

We interviewed the principal and one teacher from each of two schools, an elementary and a secondary school, and arrived at a preliminary list of twelve non-teaching tasks which might benefit from computer assistance. A questionnaire was then distributed to 10% of the teachers in the Province to confirm or expand the preliminary list. The preliminary task list, with definitions of each task, is attached as Appendix V, together with the initial ranking of tasks by the teachers interviewed.

The completed questionnaires were summarized by computer under various groupings: teacher experience, urban or rural school location, grades taught, size of school and the teacher's degree of computer knowledge. The results were surprisingly uniform and are summarized in Appendix VI.

1. Teachers Agree on the Most Onerous Non-Teaching Tasks

Teachers were asked to rank twelve tasks in the order in which they would most welcome some assistance, and to add more if they wished. In all groupings of responses, the following two tasks received more than two thirds of the responses:

- Test Construction: a data bank of test items used by others, together with teacher comments, could be a useful aid if classified by level of complexity and objective. This would permit teachers to construct a wider variety of tests, and possibly shorter tests to accomplish equivalent objectives.

- Assistance in the Development of Learning Materials: there is a continual increase in the number and variety of learning materials being produced. A data bank covering available materials, together with the comments of teachers who have used or reviewed them, and the name of a local "expert" would be beneficial to teachers by providing a broader reference base of proven learning materials.

The following three tasks received very low response in comparison to the above two:

- Assigning and Marking Tests: tests applied to particular students as well as regular testing involves teacher time, as does marking the tests and compiling statistics. There may be an opportunity to relieve the workload on the teacher while preserving the benefits of evaluating individual student progress. This would increase the time available to the teacher to analyze test results.

- Student Progress (Tracking): the attempt to individualize instruction as much as possible places a tremendous record-keeping chore on a teacher in order to monitor a large number of factors for a large number of students. Some means of organizing and structuring these factors would reduce the clerical work involved and permit more time for their correlation and analysis.

- Test Analysis: test results may be analyzed from many viewpoints in order to measure many aspects such as student results against group norms, the efficacy of teaching methodology, and the degree of standardization achieved in various geographical regions.

The remaining seven tasks received negligible scores, often not even being ranked. These are:

- Student Grades and Reports
- Student Attendance
- Curriculum Design/Development
- Inventory Control
- Timetabling

- Registration-Application-Enrollment
- Counselling

We were surprised at the low ranking of Curriculum Design/Development, which may reflect some teacher misunderstanding of our definition.

2. No Tasks of Any Significance Were Added to the Preliminary List

Although space was provided, the only other tasks listed by teachers may be classified as "chores". These involved collecting money from students for various supplies or services, supervising lunch rooms, organizing extracurricular activities and so on. As far as CBIS is concerned such tasks are of little significance, although individual schools may question whether non-teaching staff might absorb some of these activities.

3. The Applicability of a Computer to the Main Tasks Varies Considerably with Several Factors

Responses to the questionnaire were received from teachers in a wide variety of school environments, many of whom provided written comments in addition to the multiple-choice questions. From these comments, it appears that there exist several factors which could influence the potential benefits of using a computer.

The comments made by teachers include:

- The teaching-learning process tends to be more structured as the grade level increases. Thus, computer information banks are potentially more suitable to higher grade levels than lower levels.

- Computers are suited to storing and manipulating measurements rather than opinions. We might therefore expect greater benefits from test item banks and classified learning materials in courses that involve more measurable units rather than interpretive characteristics. For example, it is easier to measure whether a student has learned a mathematical theorem or geographical facts than if he has understood the irony of "Death of a Salesman" or the impact of the Greeks on the development of mathematics, and hence to classify related tests and learning aids.

- Test item banks may be far more beneficial to teachers of classes of students with physical or learning disabilities than to teachers of students with a more normal skill range. In these situations, the teacher is more likely to have to construct tests for small groups of students rather than for a whole class.

- Less common courses will benefit more than more common ones, especially from a bank of learning aid references. For instance, teachers of French as a second language appear to have more difficulty in locating reference material in Alberta than teachers of mathematics.

In particular cases, the utilization of a CBIS system will vary also with the attitudes of individual teachers towards computers.

4. Teacher Responses Were Cautiously Positive

The questionnaire included questions aimed at detecting any bias towards computers on the part of teachers. Although the comments on a few responses indicated that some teachers were categorically opposed to any use of computers, no general patterns emerged in relation to the teacher's knowledge or experience with computers, length of teaching experience, his or her specialty, or any other particular factor.

Overall, the responses indicated that most teachers thought that computers could provide benefits in the areas listed above, subject to certain provisos:

- Privacy of student information must not be compromised.
- Good system design was essential to ensure that the computer served and did not tyrannize teachers through excessive time demands and regimentation, or students through the perpetuation and distribution of outdated or ambiguous reports.

Very few of the teachers surveyed had more than a passing acquaintance with computers. Their positive attitude was therefore encouraging and their caution understandable.

The findings in this section provide one set of limits in defining a workable CBIS system. As viewed by the teacher, computers can relieve the pressure of some time-consuming tasks and enhance the teaching-learning process. The teachers appeared to be quite objective in stating which tasks, if effort were reduced, would make some difference in the quality of their teaching.

The findings indicate that there is potential for computers to assist individual teachers, but because no real attempt at CBIS has yet been made, it must be determined whether the potential for achieving benefits is worth the cost. To accomplish this, a definition of CBIS which can reasonably be expected to produce benefits must be developed.

IV. FRAMEWORKS FOR CBIS

Data may be stored to meet the needs determined in the last section in essentially three different ways:

- Private and personal records such as a personal "notepad".
  A teacher could be allocated a fixed amount of computer storage space to use as he wishes. This could be used to store subjective comments for the teacher's own personal use in tracking student progress.

- Records accessible by teachers within a single school.
  For example, student grades and the type of comments that appear on report cards could be stored for access by all teachers within a school. Such a system would store only more objective data in order to avoid the problems associated with privacy of information. This again applies mainly to tracking student progress.

- Records accessible on a province-wide basis.
  Because of cost effectiveness and privacy, this would probably contain information banks for tests and learning resources rather than individual student information.

Marking tests and test analysis have close ties with tasks outside our terms of reference, namely, computer assisted instruction (CAI) and computer managed instruction (CMI), and should not be considered

here in isolation. Furthermore, although our terms of reference did not include examining the role of school administrators, there are administrative tasks which encroach on teacher time in some school situations. For example, timetable preparation in a small school with few administrators requires more teacher time than would be required in a larger school. In addition, there is some overlap in the base data used by teachers and administrators. Therefore, although general administrative tasks were not reviewed as part of the study, it is useful to recognize some of these areas which have been identified in order that potential interfaces are not excluded. Some of these tasks are:

- Registration and enrollment, as well as monitoring attendance.
- Student scheduling, which the administration may use to allow teachers more flexibility in the use of their time.
- Systems which would permit Alberta Education or school boards to obtain summary and trend information from the banks of data in the CBIS system.

Such applications and others would no doubt be possible if a CBIS system were in place. However, it may transpire that it is these other uses which justify the creation of a computer network which in turn would support CBIS.

We now consider the practicality of each of the three categories of potential computer application.

A. PERSONAL RECORDS

Each teacher could be assigned a fixed allocation of file space to use as he wishes to record his notes and comments about his students. In effect, this is a private "notepad" which might

replace the teacher's current handwritten files. The benefit of this system is that it can provide a more compact record than manual notes and can improve recall capability. Such a system would also be easier to update than handwritten notes.

However, if records are stored on a computer there are certain pitfalls. These include:

- In order to access the records the teacher is dependent on the availability of a computer terminal.

- Handwritten notes can be as cryptic or concise as the teacher requires, but if typed into a computer they would require considerable discipline. As such, it would probably be slower and less convenient to use while providing little if any extra benefit over the teacher's handwritten notes.

- Once in a computer, there is a chance that adverse comments on students could be accessed by others or that obsolete comments could remain on file. Privacy considerations are very important because no computer system is completely foolproof.

- Teachers would probably find this process cumbersome.

Overall, this does not appear a promising area for computer support.

B. RECORDS ACCESSIBLE WITHIN ONE SCHOOL

Although there may be many potential uses of a computer by a school's administration, from a teacher's point of view the storage of individual student records appears to offer the most benefit. Objective data or comments which might appear on

report cards could be stored in order that each teacher within a school could access a student's total progress profile. Such data could be stored at various levels, from comments used only within the school which would not appear on report cards to the storage of grades and report card comments. Report cards could then be printed automatically rather than having teachers handwrite report cards as is still done in many schools.

The potential benefits include:

- A saving of teacher time in report card preparation and obtaining student profiles.

- A student record could easily be supplied to another school when a student transfers, either by printing out a copy or by telecommunication if such a link exists for some other purpose (it would hardly be justified for this purpose alone).

- Teachers would obtain a fairly comprehensive profile on new students.

- All teachers would have access to comprehensive student information recorded under common rules. Such an information base would provide a balanced student profile rather than a system which depends upon informal teacher conversations, and which may therefore tend to highlight only exceptionally good or bad student characteristics.

There are some potential drawbacks, which include:

- Some degree of standardization would be required in order that consistent and reliable information could be stored and retrieved from the computer. In other words, some discipline would be required to govern how the data is to

be recorded. However, this need be no more burdensome than the present standards for ensuring reasonable consistency in report card preparation.

- There are possible problems regarding the privacy of information. In particular, there may be strong opposition from parent groups to any hint of a computerized "dossier".

- A procedure would be required to ensure that only current information is stored and that good or bad comments do not follow the student for years if they are no longer justified.

Therefore, a student information bank could be useful to teachers who have to deal directly with that student. However, computers tend to make information more readily available than non-computerized systems and the ease of manipulating large amounts of data increases the need to purge obsolete data. Therefore, extra effort is required to ensure that computer data remains current and credible and this may require the creation of a central policing body to create and enforce the rules for storing data.

C. A PROVINCE-WIDE RESOURCE DATA BASE

If there is a need for CBIS data beyond the boundary of a single school, then the need is province-wide. For example, since instruction objectives are set by the Province, a learning aid reference or test is potentially relevant to all teachers if relevant to any. This does not preclude implementation on a regional basis.

Without exception, the teachers surveyed did not consider that a province-wide system should involve personal student records. The reasons for this included:

- Privacy of information.
- Ambiguous or malicious data could haunt a student now and in the future.
- Such data could be misleading if taken out of context, i.e. not knowing the student's total background.

Rather, it was considered desirable to have a province-wide resource data base whose contents would assist teachers to:

- Obtain learning resource references.
- Locate current "experts".
- Obtain references for improved testing.
- Obtain evaluations of learning resources by other teachers.
- Obtain actual learning and testing materials from a central repository.

Such a data base is more complex both to create and to maintain than either the private "notepad" or the student record bank. The benefits of such a resource base include:

- A much broader and comprehensive reference base than teachers can now hope to have.

- More cross-fertilization of ideas between teachers, contributing to the quicker training of new teachers.

- A reduction of time spent now in considering resources which may already have been tried and discarded by other teachers for valid reasons.

All good things have drawbacks, however, and for a province-wide data base these include:

- With such a comprehensive data base available, teachers may restrict themselves to it and not look further afield. This could have the long term effect of reducing the overall reference base of the teachers and making it more homogeneous, while increasing the reference base of individual teachers in the short term.

- A province-wide data base requires strict standards for entering, using and deleting the information it contains. Some administrative body would have to be established with the authority to control data base activity. We understand that Alberta Education spends considerable time now maintaining a test item bank manually. A computerized system could assist this activity, although its investigation did not fall within the terms of reference for this study.

- It is possible to consider that such a data base should be linked to a central library of actual materials. In this case, all of the requirements of establishing a new library would be involved. This is a large undertaking and has significant organizational, funding and other administrative implications.

- Teachers may not use it, preferring their own personal contacts.

We have identified the three main areas for potential computer use. However, before we can consider the feasible technological alternatives, we should consider the limitations arising from how teachers could access or use such a facility.

V. HOW TEACHERS CAN ACCESS A COMPUTER

There are essentially three ways in which a teacher can access a computer system in a practical manner:

- Directly through a personal terminal.
- Directly through a communal terminal.
- Indirectly through an intermediary with direct access to the computer (a minor variation on this is where the intermediary must deal through another intermediary, such as a remote terminal or data centre).

The first two approaches are essential if the teacher is to have the "notepad" facility discussed earlier.

Direct use of a personal terminal implies that each teacher has his own computer terminal, logically best located in the classroom. This will be expensive on a province- wide basis, involving an expenditure of approximately $400 million for terminals alone (estimated 20,000 classrooms X approximately $2,000 per terminal). More importantly, however, such a terminal would be vulnerable to tampering by schoolchildren if left in the classroom. This is therefore not a feasible option unless teachers were to obtain portable terminals

with an acoustic coupler. This is hardly a realistic alternative to handwritten notes and indeed is completely unnecessary for access to a province-wide data base since we see no reason for any one teacher to require continuous access to such a data base.

The second alternative, a communal terminal, is certainly more practical from the viewpoint of preserving privacy of information. The terminal could be in a locked room to which teachers have a key. However, the lack of immediate access negates its value as a "notepad". However, a communal terminal in a locked room could be used to access a large data base.

The final alternative, teachers dealing through an intermediary, is really a variation of the communal terminal but with a specific operator, perhaps a school secretary, to communicate directly with the computer. Again, the lack of immediacy negates its value as a "notepad", but it could be used to access a large data base. This approach would minimize the amount of teacher training involved, and in addition, is the one most likely to preserve data integrity and privacy of information.

We consider the third alternative to be clearly the most feasible.

VI. THE SCOPE AND REQUIREMENTS OF A PRACTICAL CBIS SYSTEM

Combining the frameworks for CBIS discussed previously with the ways in which a teacher can access a computer system, we arrive at a set of applications which may be considered practical. In this section, we will discuss the factors influencing the scope of a CBIS system which has the potential to assist teachers and which they can use conveniently. The section will conclude with a definition of CBIS.

A. PERSONAL "NOTEPAD"

As noted earlier, the requirements of a "notepad" are in conflict. Immediacy of access conflicts with privacy of information considerations and this does not encourage the use of such a facility. In addition, such a facility would be cumbersome to use in comparison with handwritten notes. We therefore do not consider this to be a practical application.

B. RECORDS ACCESSIBLE WITHIN A SCHOOL

In an earlier section we considered that records required only within a school would essentially be student progress profiles. Teachers require occasional reference to these records as well as the ability to update them periodically. The practicalities of operating a computer terminal as well as preserving the accuracy of the data stored in the computer leads us to believe that an operator would be required. Teachers would not have direct access to update or retrieve computer records. Thus, privacy is also secured.

Such records are usually required only within each school, unless a student transfers. Therefore, it would be desirable to store these records at the school level in order to avoid the line costs of using a remote resource.

C. PROVINCE-WIDE RESOURCE DATA BASE

Here we have several different sets of requirements for the various possible resource item banks or libraries. However, there are some general common characteristics which we note first. These include:

- Such a data base should be accessible on a province-wide basis.

- An operator will probably be required for the same reason as discussed in Section V.

- This is essentially a library "look up" system and so will involve relatively low processing capability, high message switching capabilities, and a good data base handler.

- Very large data storage is involved.

- There are no privacy considerations because no personal data is available on a province-wide basis.

- It would require a central organization for controlling the use of the computer system and the addition, retrieval or deletion of data from it. A central resource would also be required to provide technical support in the event that problems were experienced by a particular school.

- The speed with which data is accessed will depend to some degree on whether a central repository of materials is to be established. There is no point in providing rapid references if the Province or other schools cannot deliver the materials quickly.

In addition to these common characteristics, there are particular requirements for the individual data bases as stated below.

1. Learning Resource References

   Teachers would like to be able to be more aware of papers, publications and other materials that other teachers have found useful. There is an informal system

in place now where teachers follow up their own sources and contacts when conducting research.

In order to broaden the teacher's contact base and streamline his ability to find useful sources, some classified bank of data would be very useful. This agrees with our own judgement as well as the teacher surveys.

Such a data bank could be organized formally with rules for the classification of information, coding conventions, retention periods and the entry of data into the data bank. This would require a central administrative unit to coordinate and collect the relevant data from teachers. If done for all schools in all subjects, this could involve significant overhead costs to operate. The multiplicity of data sources, namely from every teacher, and the need to adhere to strict standards would probably result in a considerable delay in entering data into the system as well as a high rate of items returned for further clarification. A formal system, therefore, requires central management.

Alternatively, it could be argued that the teachers who would best use such a facility are those who are doing the best they can now on a less formal basis, and that those who are not doing so now would not use a computerized data bank. If so, there is an approach which would provide a data bank with relatively little overhead required to run it once the rules for its use are established. This approach would essentially extend the present informal system by allowing teachers, or their school operator, to input references and opinions subject to specified rules. Such a bank of data would be allocated an amount of storage and purged automatically

depending on the age of the reference. An automatic purge would be essential for such a data bank. Each school would still have to procure any particular books or kits as they do now. Such an approach might form the entire system or the first step in the development of a larger data bank and a more formal centralized approach.

An informal system offers practical advantages as far as getting it established is concerned. Such a system could be run on local computers funded by local boards of education. The only requirement from a central standpoint could be to ensure that some central standards were established in order to ensure compatability between the various system components. A centralized technical resource would probably be required in order to assist when the system did not work. Finally, a central "court of appeal" would have to be established to manage the operation of the data bank and resolve any unilateral actions by schools which might destroy the integrity of the data base.

In other words, the choices for a data bank of learning resource references would be to have either a formal, standardized, centralized data base or a computer-based extension of the present "word of mouth" system. The former approach has advantages when combined with what is discussed in the next section, while the latter has advantages in that it can be implemented by individual school boards.

2. Learning Resource Library

Teachers were concerned that new learning kits and texts are obtained now on a somewhat random basis, depending upon which teachers have seen which publishers'

advertisements. Another complaint was that such items must be reserved well in advance of need if their availability is to be ensured.

A central resource library could be established and linked to a formal computer system which identifies the materials available as well as providing instructions on how to obtain them from this central library. The costs involved in such an approach could be very large. For example, it would be necessary to establish:

- A central organization to obtain, evaluate, and classify new materials.
- A central storage facility for the acquired materials.
- A transportation network to distribute materials to schools.
- A monitoring system in order to control the use and return of materials.

In addition, the central body of staff would have to be well chosen to instill credibility in their evaluations. Furthermore, since all teachers in the Province are potential evaluators of materials at present, the number of evaluators would be reduced thereby possibly delaying the introduction of new learning materials. On the other hand, many teachers no doubt review the same material now, so a central body would therefore eliminate some duplication of effort.

A central library of learning materials could either be designated as the sole source of supply for teachers in the Province in order to avoid the duplication of purchasing, or alternatively, it could merely be supplementary to the continuing purchases of schools as they are at present. In either case, however, we consider the potential costs to be very high and a much more accurate determination of the benefits must be undertaken prior to proceeding with such a facility.

3. Test Item Banks

There is at least one commercial system currently available which will store actual test items and permit their retrieval by teachers within a single school. On a province-wide basis, however, the amount of storage required for actual test items could be very high.

Because tests relate to course objectives which are set provincially, this data base must be well controlled. This implies a structure, and a central processing and coordinating body. In order for such a bank of data to be useful, criteria will need to be established which govern the items to be stored within the system. For example, it does not seem practical to rely simply upon a particular teacher's preference. This implies that a committee structure will be involved in order to approve additions to the data base. Statistical monitoring of items, which is done now on a manual basis, could be facilitated through computerized records.

4. Tracking Student Progress

Many of the teachers who responded to our questionnaire stated that they would like to be able to give more individualized instruction to students, but that there

were physical limits to their ability to monitor all the variables of progress for all of their students. A paper written by W. E. Hathaway of Alberta Education describes a method called "A Network Based Approach to Curriculum Development", which involves the development of a PERT-like chart for each course. This chart relates provincial objectives down to units of achievement to be acquired by students. To the extent that such a course specification is possible, a computer could track student progress. Such a system would operate on a local computer, with the data being available province-wide.

D. A DEFINITION OF A CBIS SYSTEM

A definition of a CBIS system involves three aspects: how teachers will use the system, what data it contains and where the data is to be stored. From this definition it will then be possible to construct a particular CBIS system considering costs and organizational implications.

We define a CBIS system as follows: A system for Computer Based Instructional Support is for use by individual teachers at their discretion. It contains information banks which reduces the amount of teacher time involved in accessing information. The information is stored nearest the location where it is needed, subject to cost and organizational implications.

Based upon this definition, we can summarize in the following table the description of the CBIS system which has emerged so far:

	School or School Board	Central Organization
Student Records	- Local computer file - Print & mail student profile on transfer	-
Learning Aid References	- Local computer file, accessible by other computers at other schools (only if no central resources library)	- Central control of procedures & technical support, if no resource library - Central file if a library of learning resources is justified
Test Item Banks or References	- No local system - Use local computer to access central bank	- Large central computer - Central library of test material.

Each school would have at least a computer terminal, larger schools may have a smaller computer. The terminal would not normally be used by teaching staff, but by an operator. This approach to CBIS has the advantage that it can be developed in stages and recognizes school board jurisdictions.

In this section we have defined the scope of CBIS in practical terms based upon the needs specified by teachers and the operational feasibility of alternatives to meet these needs. Now we must consider whether current data processing technology can support such a CBIS system and at what cost.

VII. TECHNOLOGY REQUIREMENTS AND FEASIBLE ALTERNATIVES

Certain technological requirements must be met if a CBIS system is to be built as described above. In this section we will identify these technological requirements and the alternatives for meeting them. In addition, we will examine their organizational and cost implications.

Some rather large dollar values are contained in this section, but it should be remembered that in this study we are considering CBIS in isolation. Therefore, in the last part of this section we will bring these costs into perspective.

A. BROAD TECHNOLOGICAL REQUIREMENTS FOR THE DEFINED CBIS

The requirements which EDP technology must satisfy if it is to fulfill the needs discussed in the last section are identified below.

- There is a need for both local and provincial level data storage and processing.

- A high storage capacity is required to accommodate the identified data banks.

- In the approaches which use a central facility, there is a need for very high message switching capabilities. Remember that approximately 1,400 schools will be accessing the central resource in these circumstances, not to mention school boards and perhaps Alberta Education as well.

- A well designed data base is critical and may need to involve well qualified data base experts due to its sheer magnitude.

- A bi-structured data base is involved with very little interaction between the two components. Student records which are unique to schools and involve privacy considerations may have to be handled locally and be protected from access by unauthorized sources. The resources data base is accessible province-wide and involves no privacy considerations.

- The major programming effort will be concerned with data base management since the main usage of these data bases will be retrieval of individual items rather than complex computer processing.

In view of these conditions, it was necessary to explore the capabilities and cost of current data processing technology. In this regard, we met with Sperry Univac and NCR which are companies capable of providing the required resources. Our intention was to discover whether current technology provided a wide enough range of alternatives to meet the above requirements. In particular, we wished to ascertain that enough compatible components are available to accommodate the needs of small rural schools as well as large city schools. It was also necessary to examine current data base management systems in order to find out whether they can support the levels of activity involved here. Both computer companies stated that they had installed systems of a size and structure similar to the requirements of CBIS, and we are reassured that CBIS is therefore technologically feasible.

Proceeding with either the local or province-wide network constitutes a major project from both a resource and organizational point of view. Many questions of jurisdiction, sources of funding, interference with local school board autonomy, and other questions must be considered when devising a solution.

B. THE AVAILABLE EDP ALTERNATIVES

The need for some centralized computer installation restricts the choice of hardware suppliers to about two or three major

companies. This in turn will restrict the choice of local hardware depending on its compatibility with the central resource, which means that only IBM compatible equipment should be used throughout the Province since this is the nearest thing to a universal standard.

There are essentially two fundamentally different alternatives representing the extremes of centralization and decentralization which meet all of the identified requirements of CBIS. However, many hybrid configurations are possible and even likely if CBIS is introduced. A third alternative is available if we modify the definition of CBIS to exclude a test item bank, or if we eliminate the possibility of a central resource library. These three alternatives are:

- Centralized

  A central computer to handle all file storage and processing, with terminals at each school. This approach is essential if a central resource library is considered possible.

- Partially Decentralized

  A small computer in each school, or at least at the school board with terminals in the schools, to handle storage and processing for student records and learning aid references. A central computer would be required for a test item bank.

- Totally Decentralized (With Amended CBIS)

  Earlier in the report, we discussed why a test item bank needs centralized control. However, if the test item bank and central resource library are excluded, then a totally decentralized system is possible with computers only in schools or school boards.

It is quite likely that a province-wide application of computers would result in hybrid combinations of these three approaches. For simplicity, we consider each one separately here. These alternatives are defined in detail in Appendix VII and compared in Appendix VIII. Each alternative has its merits and a summary is presented here.

1. <u>All Three Alternatives Involve a Large Cost for Hardware</u>

   Two of the approaches require a central computer at a cost of about $1 million, as well as at least one terminal in each of 1400 schools for a cost of about $2.8 million. In addition, the partially decentralized alternative involves approximately another $5 million for local computers in schools and school boards. The totally decentralized option involves a total cost of about $8 million for hardware, but excludes the test item bank. In other words, the three alterantives cost about $4 million, $9 million and $8 million respectively for computer hardware alone, reduced by whatever suitable computer equipment is already installed in schools and school boards.

2. <u>A Central Computer Requires an Organization to Run It</u>

   A central computer of the size discussed above requires a significant staff to make it work. This involves a continuing expense for salaries and office space; even more so if the central facility includes a library of actual learning materials or tests.

   In addition, rules would have to be worked out with school boards to govern reporting relationships, funding, responsibilities and the preservation of local autonomy. These rules should be agreed first, which could delay the actual implementation of the central facility.

A decentralized approach requires a much smaller central support group to provide rules to ensure consistent data bases as well as technical support.

3. The Decentralized Approach is Simpler to Initiate

The decentralized approach can be phased in over time, and may even be able to use computer hardware which is already in place. Otherwise, local boards can fund their own computers. The only guidelines that must be established first are those that ensure that school boards choose computers and systems that are compatible. This approach can therefore begin with modest cost and effort.

4. The Quality of Operation of the Centralized Approach Is Easier to Control

Once a CBIS system is established, it is easier for individual school boards to attempt to modify their own systems than if a centrally controlled system were in place. This can lead to incompatibility through unauthorized change. The vendors with whom we discussed this system also felt that current technology was far more reliable in the case of a centralized approach and quoted examples of installations in Japan and the U.K. of similar size.

In short, the centralized alternative is the least expensive in terms of computer hardware but involves the largest organizational considerations. The partially decentralized alternative involves this and the coordination of local computers. The totally decentralized approach is the simplest from an organizational viewpoint but loses a significant part of the

potential CBIS system. These, then are the alternatives. We are now ready to examine their economic feasibility.

C. A PERSPECTIVE ON COSTS AND BENEFITS

The potential benefits of CBIS are:

- A saving in teacher time.
- A broadened reference base for tests and learning aids, leading to better structured instruction or more efficient testing.

Because of the diverse school environments occurring in Alberta, a much more extensive study than ours would be required to quantify these benefits through time studies. Even then, it will be a judgement as to whether the kind of expenditure discussed above is warranted.

The costs, however, can be estimated with somewhat more precision. In earlier sections, the minimum cost for computer hardware was estimated at $5 million to $9 million, with additional costs being required for telecommunications and for an organization to develop, manage and operate the computer system.

It must be realized, however, that the terms of reference for the study covered only one aspect of computer use in the educational process. Before a final decision can be made about CBIS, the results of this study need to be consolidated with other studies of computerization which ran concurrently with this one. These studies include Computer Assisted Instruction (CAI) and Computer Managed Instruction (CMI).

CAI, CMI and administrative uses virtually guarantee that the amount of computer power in schools, school boards and related organizations will increase. This being the case, it seems reasonable to guide this development so that the ability to implement CBIS is not excluded through the development of incompatible systems. Thus, it may well prove possible to obtain the benefits of CBIS at very reasonable incremental cost because of the natural relationships between the various applications. For example, CAI equipment can be used to test students which suggests a natural link to test item banks. The results of tests can be stored for subsequent analysis by teachers, school boards and Alberta Education; as well as to print report cards and accumulate student profiles. School administrations can use stored student records to assist in planning, budgeting and monitoring inventories. These examples can only hint at the vast potential benefits which can be derived from shared data banks, provided that the systems which evolve are technologically compatible and use common data standards. It would be unfortunate if such benefits were forgone simply through lack of foresight.

CBIS as defined appears to be technologically feasible and can become cost effective provided that it is part of an overall plan for computerization within a Province-wide framework.

VIII. RECOMMENDATION AND A FORWARD PLAN

It has been established that a practical and technologically feasible approach to CBIS exists but that economic feasibility will depend upon careful planning. If widespread computerization already exists in the Province, then we are somewhat at the mercy of the level of compatibility which already exists between the various installations. However, if such a level of computerization does not exist, then the

Department should ensure that computers are introduced in the right way while also investigating in more detail the feasibility of CBIS as defined in this report. A plan is suggested below which will accomplish this.

A. EXAMINE THE TOTAL REQUIREMENTS FOR COMPUTER POWER

The Department should establish the total need for computers in schools and school boards. In other words, the level of computerization required for CAI, CMI and administration should be determined in order to calculate the incremental cost of CBIS. Some of this information may be obtainable from other studies which we understand the Department is conducting concurrently with this one. This will provide the framework for planning the further growth of computerization within educational institutions.

B. DETERMINE THE CURRENT LEVEL AND QUALITY OF COMPUTERIZATION IN SCHOOLS AND SCHOOL BOARDS WITHIN THE PROVINCE

The current level of computerization which currently exists within the Province should be established. This involves surveying all schools and school boards in order to determine:

- What policies and guidelines exist for computer acquisition and system development.
- Current hardware and software available and in use.
- Current applications being used and under development.
- Plans for further computerization which exist.

- The quality of the computer programs and standards in use at current installations.

- The compatibility of these standards.

This will provide a snapshot of the present network of computers throughout the Province and the basis for constructing a precise plan for further development.

C. FORMULATE A POLICY TO GUIDE FURTHER SYSTEM DEVELOPMENT

The Department should now formulate a policy that aims at preserving the autonomy of local school boards, but which ensures that compatibility and coordination will be achieved with any new hardware acquisitions or system software. This will also involve the first phase of establishing a centralized coordinating body and its terms of reference should be developed at this stage.

D. ESTABLISH A PILOT PROJECT WITHIN ONE SCHOOL BOARD

A pilot project should be established to determine the deliverable benefits of CBIS. In order to test the degree to which teachers actually use references from beyond their own school, the pilot project should span a school board. It should also continue for sufficient time to determine whether its utility is enduring. A pilot project will involve:

- Purchasing or renting a small computer, unless performed in a school board which already has sufficient computer power.

- Obtaining the use of some vendor's large computer to simulate the central computer required for CBIS.

- Hiring two or three excellently qualified data base experts to design the file structure.

- Training some teachers to participate in the pilot study.

Costs could be kept down by negotiating with the hardware vendor participating in the pilot project on the basis of possible future sales. Following the pilot study, costs and benefits should be reviewed and confirmed.

E. CONFIRM THE FEASIBILITY OF CBIS

In view of the foregoing research and pilot project, the Department should now confirm the feasibility and practicability of the recommendation.

Upon the completion of this plan, the Department will be in an excellent position to assess the real value of CBIS before committing to full scale system development.

IX. CONCLUSION

We would like to express our appreciation for the cooperation which we have obtained throughout this study from Alberta Education, Westboro Elementary School and Ardrossan Jr.-Sr. High School. We would also like to thank all of the teachers who completed our questionnaire.

For our part, we are privileged to have been part of a study which examines a very new concept, and we take this opportunity to thank Alberta Education for the opportunity to assist in such an important project.

CURRIE, COOPERS & LYBRAND LTD.

Allan Brown

Allan Brown

ALBERTA EDUCATION

SUMMARY OF OUR TERMS OF REFERENCE

III. OBJECTIVES OF THE STUDY

Alberta Education is trying to achieve an overall perspective of the different environments which can evolve throughout the Provincial educational system in coming years. The proposed study is required to identify those areas of classroom administration which lend themselves to enhancement through computerization, and to assess the implications of using modern communications and computer technology in those areas.

The study must therefore result in a report that addresses the following issues:

- A clear statement of the common classroom administration procedures.
- A description of the various alternatives open to the Department to enhance classroom administration, including organizational considerations within each school and throughout the province.
- An evaluation of the technical and operational feasibility of the various alternatives.
- An analysis and assessment of the implications of each of the feasible alternatives.
- Estimates of the major costs of the feasible alternatives.
- An assessment of how these improvements can be introduced in a typical classroom, and of the benefits to be expected in terms of the quality of education provided to students.

In summary, the Department wishes to be in a position to enrich the classroom administration progress without detracting from teacher effectiveness

or creativity. We concur with the Department's statement that, in order to do so, it is first necessary to carry out a feasibility study on the basis of the existing outline plan. In the next section of this proposal we have described the approach which we would take in order to complete such an assignment.

IV. OUR APPROACH TO THE ASSIGNMENT

Based upon our understanding of your requirements and our experience in conducting similar studies, we suggest an approach which will involve five distinct work phases. These will be organized to provide a logical staging of the project and to allow progress to be monitored continually by the Department. Indeed, we specifically recommend a series of check-point meetings throughout the assignment to review our findings as the study progresses and to allow the Department to evaluate overall feasibili and desirability of the various recommendations as they emerge.

Appendix II to this proposal shows a suggested work plan for a project organized in such a manner. We have outlined below the details of each step to be carried out during the assignment.

A. MEET WITH THE STEERING COMMITTEE TO AGREE TO THE PROJECT PLAN

We understand that the Department will establish a Steering Committee to monitor the assignment, and that senior members of the Department will be appointed to this committee. We also concur with the Depart-ment that the appointment of at least one member of the Alberta Teachs Association will help to ensure that subsequent interviews are chosen wisely, and that the overall objective of the assignment is properly seen to be an improvement in classroom administration.

We propose to hold an initial project start-up meeting with the Steering Committee, to review the project and ensure that there is a clear and mutual understanding of our terms of reference prior to commencement of detailed work. At this meeting we will also seek to

confirm the work plan shown in Appendix II.

We will also identify precise interviewing requirements and ask the Department to establish an interviewing schedule which will allow our consultants to hold detailed meetings with specific individuals at particular institutions.

B. STUDY CURRENT RESEARCH AND INVESTIGATE OTHER INSTITUTIONS

We will conduct a review of relevant literature, and the research and experience of other educational institutions across Canada.

In particular, we will review the work being done at Mohawk College and Humber College in Toronto, and at other institutions where work is being undertaken in the area of computer assisted classroom administration. We will also draw upon our own experience in developing on-line interactive computer systems in assessing the technical aspects of our findings.

C. IDENTIFY AND EVALUATE CLASSROOM ADMINISTRATIVE TASKS

Once the Department has arranged the schedule of interviews agreed to in the preceding step, we propose to talk to teachers and principals in several institutions covering kindergarten through grade 12. In the course of these interviews, we will also spend a considerable amount of time in selected classes to observe classroom routine. This will form the basis for the extensive systems review and analysis necessary to arrive at meaningful conclusions.

This phase of the assignment is crucial to the overall success of the project. Its main thrust is qualitative rather than quantitative, and it is expected that it will progress in the following general way:

- Meet with the Steering Committee to identify and classify the groups to be studied.
- Conduct interviews with representatives in each identified group, and carry ouz initial observations.

- Review findings and identify the classroom practices that appear to be logical candidates for further study.
- Confirm these conclusions with the Steering Committee and through further interviews.
- Repeat these steps as necessary until the conclusions are established to the satisfaction of the Steering Committee.
- Proceed now to conduct further interviews and classroom observations to verify the conclusions in depth, and to form viable hypotheses concerning the use of computers in classroom administration.
- Evaluate our findings and develop hypotheses that address the objectives of the assignment.
- Test these hypotheses by reviewing them with the Department, and through subsequent interviews and observations.

The data gathered in this step of the assignment will form by far the most important and relevant information base on which to base our subsequent feasibility analysis.

D. ASSESS FEASIBLE APPROACHES TO CBIS

Having conducted extensive research of actual classroom situations and having reviewed current research and literature in detail, we will next proceed to consolidate our findings in order to identify the feasible approaches to computer-based instructional support which are open to the Department. Each approach will be investigated in detail. We will assess its implications in regard to generality of application, its potential ability to free the teacher from administrative overhead, and its feasibility as a classroom tool.

E. DOCUMENT FEASIBLE APPROACHES AND PRESENT CONCLUSIONS TO THE STEERING COMMITTEE

The last step of the project will involve the preparation and presentation of a detailed report which clearly identifies the alternatives open to Alberta Education with regard to computer-based instructional support systems. This will include a full discussion of the implications of each alternative, outling its potential scope and general applicability throughout the Province.

We expect to liaise closely with the Steering Committee at each stage of the work plan described above, and to acquaint them with our interim findings on a regular basis as the project progresses, through formal checkpoint meetings and scheduled project review meetings.

At the conclusion of this assignment, Alberta Education will thus be in a position to assess each feasible approach in the context of province-wide objectives. Our consultants will also be prepared to undertake further assignments during the succeeding implementation phase, if the Department wishes to preserve continuity of involvement.

ALBERTA EDUCATION

REFERENCE SOURCES FOR THE LITERATURE SEARCH

A. LIST OF COMPUTER MANUFACTURERS CONTACTED

In order to find out what was actually being done with computers to assist teachers, we contacted the leading computer manufacturers in North America. These included:

Burroughs Ltd.
Control Data Corporation
Data General (Canada) Ltd.
Digital Equipment of Canada Ltd.
Hewlett-Packard Ltd.
Honeywell Canada Ltd.
IBM Canada Ltd.
IP Sharp
MAI Canada Ltd.
NCR Canada Ltd.
Sperry Univac of Canada Ltd.

IBM and Hewlett-Packard supplied brochures and descriptions of some applications but these were concerned only with computer-assisted instruction and basic accounting systems. MAI provided a contact which led to many of the references listed in the next section of this Appendix. Nothing of significance was received from the others listed above.

B. LIST OF CONTACTS FOR CURRENT RESEARCH

Algonquin College, Ottawa, Ontario
American Association of School Administrators - Education Research Centre, Arlington, Virginia, U.S.A.
Dr. Marvin Daley, consultant, Colorado Springs, U.S.A.
Grant McEwan Community College, Edmonton, Alberta
Humber College, Toronto, Ontario
Mohawk College, Toronto, Ontario
National Centre for Higher Education Management Studies, Boulder, Colorado, U.S.A.
Queens University, Ontario
Seneca College, Toronto, Ontario
Sir John A. MacDonald High School, Ottawa, Ontario
Unified School System, Racine, Wisconsin, U.S.A.
University of Alberta, Faculty of Education, Edmonton, Alberta
Western Interstate Commission on Higher Education, Boulder, Colorado, U.S.A.

ALBERTA EDUCATION

OUTLINE QUESTIONNAIRE FOR NON-TEACHING WORKLOAD

PURPOSE:

- To identify the non-teaching tasks required of teachers to support the teaching function in various school environments throughout the Province of Alberta.
- To rank these identified tasks in order of time consumption.

WHO IS TO ANSWER:

- Replies are solicited only from teachers actively engaged currently in classroom instruction.

WHERE SHOULD RESPONSES BE RECORDED:

- Please answer directly on the questionnaire and return your annotated copy.

DEFINITIONS:

- Definitions of terms used are in Appendix I.

I. YOUR SCHOOL

1. Name of School _____

School Address _____

Name of School County, Division or District _____

District No. _____

2. Size of School

No. of Teachers _____

No. of Students _____

No. of non-teaching Administrative Staff _____

3. What range of grades are under your principal's charge?

Circle one:

1. Grades 1 - 6
2. Grades 7 - 9
3. Grades 10-12
4. Grades 1 - 9
5. Grades 7 - 12
6. Grades 1 - 12
7. Other: specify grades _____

4. What is the maximum number of students to whom you give instruction in any one class period? _____

5. Which of the following centres is closest to your school?

Circle one:

1. Edmonton
2. Calgary
3. Lethbridge
4. Grande Prairie
5. Red Deer
6. Medicine Hat

State approximate distance in kilometres: _____

II. ABOUT YOU

6. Name _____
(this is optional; you may be contacted for a confidential interview)

7. Circle the item number indicating your completed years of teaching experience.

1. Less than 1 year
2. 1 year
3. 2 years
4. 3 years
5. 4 years
6. 5-10 years
7. over 10 years

8. What grades do you teach mainly? Circle one:

1. Grades 1-3
2. Grades 4-6
3. Grades 7-9
4. Grades 10-12
5. Other (specify): _____

9. If you teach to split grades, please indicate which grades.
_____

10. In what subjects or special education tasks are you mainly involved? _____
_____
_____
_____

III. Please refer as necessary to the definitions of Appendix I.

11. To what extent are you involved in curriculum design and development? Circle one:

1. Curriculum is provided and stable
2. Curriculum requires minor modifications on a day to day basis
3. Curriculum requires some modification year to year
4. Curriculum requires significant modification
5. Major development time involved developing new courses

12. In designing curricula do you encounter any of the following:

- difficulty in addressing <u>all</u> course objectives. Circle one:

1. No difficulty
2. Some difficulty
3. Moderate difficulty
4. Significant difficulty
5. Almost impossible

- difficulty obtaining subject descriptions, course objectives, syllabi, programs of study, or curriculum guides. Circle one:

1. No difficulty
2. Some difficulty
3. Moderate difficulty
4. Significant difficulty
5. Almost impossible

- difficulty in judging the adequacy of designed curricula. Circle one:

1. No difficulty
2. Some difficulty
3. Moderate difficulty
4. Significant difficulty
5. Almost impossible

- difficulty in comparing how other schools/districts are coping. Circle one:
  1. No difficulty
  2. Some difficulty
  3. Moderate difficulty
  4. Significant difficulty
  5. Almost impossible

- difficulty in adapting curricula to local conditions while still meeting provincial objectives. Circle one:
  1. No difficulty
  2. Some difficulty
  3. Moderate difficulty
  4. Significant difficulty
  5. Almost impossible

- difficulty in adapting curricula in particular remedial situations while maintaining overall provincial objectives. Circle one:
  1. No difficulty
  2. Some difficulty
  3. Moderate difficulty
  4. Significant difficulty
  5. Almost impossible

13. Other concerns regarding curriculum design (Please specify):

_____

_____

_____

_____

_____

14. To what extent are you involved in constructing tests for students? Circle one:

    1. No involvement
    2. Occasional involvement
    3. Moderate involvement
    4. Singificant involvement
    5. A very large involvement

15. When constructing tests, do you refer to:

- previous tests used in your school? Circle one:

    1. Always use
    2. Usually use
    3. Sometimes use
    4. Seldom use
    5. Never use

- tests used in other schools? Circle one:

    1. Always use
    2. Usually use
    3. Sometimes use
    4. Seldom use
    5. Never use

- standardized or commercially prepared tests? Circle one:

    1. Always use
    2. Usually use
    3. Sometimes use
    4. Seldom use
    5. Never use

16. Do you consider it unnecessary or undesirable to refer to other tests? Circle one:

    1. Completely unnecessary
    2. Unnecessary but sometimes useful
    3. Unnecessary but usually desirable
    4. Important and very useful
    5. Absolutely essential

17. Do you find it difficult to obtain samples of other suitable tests? Circle one:

    1. Very difficult
    2. Somewhat difficult
    3. Sometimes difficult, sometimes easy
    4. Fairly easy
    5. Very easy

18. Rank the following types of tests in order of increasing difficulty of preparation (1 = simplest, 2 = next most difficult, etc.) Add more types of testing if you wish.

    _____ Knowledge
    _____ General Achievement
    _____ Attitudes, values, etc.
    _____ Diagnostic
    _____ Comprehension
    _____ Creativity
    _____ Application
    _____ _____
    _____ _____
    _____ _____

19. Can you describe briefly the kinds of difficulties experienced in test construction? _____

_____

_____

_____

_____

20. In constructing tests, what kind of difficulties peculiar to your teaching specialty do you face? Please elaborate.

_____

_____

_____

_____

21. Do the tests you mark involve essay or explanatory responses rather than multiple-choice or right or wrong responses? Circle one:

1. Entirely essay
2. Mainly essay
3. Half essay, half right-wrong
4. Mainly right-wrong
5. Entirely right-wrong.

22. Do you administer mainly individual or class tests? Circle one:

1. Mainly individual tests
2. About equal individual and class tests
3. Mainly class tests.

23. Do you attempt to analyze or interpret the results of tests? Circle one:

1. Generally yes
2. Generally no

Is this a meaningful and useful task to you? Circle one:

1. No
2. Interesting but of little importance
3. Somewhat useful
4. Very valuable
5. Essential

- Are you able to perform as much analysis as you would like to? Circle one:
  1. Generally yes
  2. Generally no

- If No, is this because you lack the necessary data or time? Circle one:
  1. Data not available
  2. Data available, but not enough time available

- Would you do more analysis or correlation if the tasks of collecting and calculating were reduced? Circle one:
  1. No, because not useful
  2. No, but it would save time
  3. A little more
  4. Considerably more
  5. A lot more, this is just what I've been waiting for.

- Rate your analysis activities in terms of value, effort and difficulty. Circle one from each column:

1. Very little value	1. Requires little effort	1. Not very difficult
2. Occasionally useful	2. Moderate effort	2. Moderate difficulty
3. Usually useful	3. Very time consuming and much effort	3. Very difficult
4. Extremely valuable		
5. Indispensable		

24. Do you compare test results to:

- previous results by the same class? Circle one:
    1. Generally yes
    2. Sometimes
    3. Generally no

- results of other classes? Circle one:
    1. Generally yes
    2. Sometimes
    3. Generally no

- If No, is this because the data is unobtainable or because the comparison is not useful? Circle one:
    1. Data unobtainable
    2. Data available but no time
    3. Comparison not useful.

25. How would you like to change the testing methods which you now use in order to improve the usefulness of the results? Please elaborate. _____

_____

_____

26. Would you like to have a source of reference which identifies and catalogues all available tests used in the province? Circle one:
    1. Like very much
    2. Nice but not essential
    3. No

27. Are you satisfied with your present ability to identify and acquire all of the learning materials you need? Circle one:
    1. Very satisfied
    2. Somewhat satisfied
    3. Somewhat dissatisfied
    4. Very dissatisfied

28. Would you like to have a source of reference which identifies and catalogues all available learning aids? Circle one:

    1. Like very much
    2. Nice but not essential
    3. No

29. Would you like to be able to find out more about the experiences of other teachers with specific learning materials? Circle one:

    1. Generally yes
    2. Occasionally
    3. Generally no

30. Are you presently able to find references to learning materials, texts, or articles quickly and easily? Circle one:

    1. Generally yes
    2. Sometimes
    3. Generally no

31. Do you wish you could augment your ability to know of reference sources outside your own direct knowledge? Circle one:

    1. Very much
    2. Generally yes
    3. Occasionally
    4. Generally no

32. Is it difficult to assess available learning materials in terms of provincial objectives? Circle one:

    1. Generally yes
    2. Sometimes
    3. Generally no

33. Are you concerned about a lack of uniformity in applying source materials in different schools? Circle one:

    1. Generally yes
    2. Sometimes
    3. Generally no

34. Is there a need to conduct tests of new materials in order for teachers to decide whether to use them? Circle one:

    1. Generally yes
    2. Sometimes
    3. Generally no

35. Do you analyze test results to check on the validity of teaching methodology? Circle one:

    1. Usually analyze test results thoroughly
    2. Sometimes analyze test results
    3. Seldom analyze test results but would like to do more
    4. Never analyze test results because conclusions are not useful
    5. Never analyze test results due to lack of time

36. Do you analyze test results to measure the validity or appropriateness of the tests? Circle one:

    1. Usually analyze test results thoroughly
    2. Sometimes analyze test results
    3. Seldom analyze test results but would like to do more
    4. Never analyze test results because conclusions are not useful
    5. Never analyze test results due to lack of time

37. Do you try to relate test results to provincial objectives? Circle one:

    1. Always
    2. Sometimes
    3. Seldom
    4. Never

38. Do you maintain your own private records of individual students? Circle one:

    1. Full records for all students
    2. Some records for all students
    3. Records maintained for particular students only
    4. Don't maintain student records
    5. Would like to maintain more records but time does not permit it.

39. What degree of individualized instruction do you provide for your students? Circle one:

    1. Individual programs for all students
    2. Individual programs for most students
    3. Individual programs for some students
    4. Individual programs for a few students
    5. No individual programs

40. How much time is involved in maintaining individual student records? Circle one:

    1. A large amount of time
    2. Some time
    3. Not much time
    4. No time

41. In assigning student grades and reports, where is the bulk of the work? Circle one:

    1. Marking assignments and tests
    2. Compiling reports
    3. Calculating student averages and final grades
    4. Other (specify): _____

    _____

42. Do you keep attendance records? Circle one:

    1. Daily
    2. Weekly
    3. Infrequent
    4. Irregular
    5. Never

43. How much of your time is taken up in preparing timetables or reducing schedule conflicts? Circle one:

    1. Significant time
    2. Not much time
    3. No time

44. Are you involved in registration or enrollment activities? Circle one:

    1. A lot
    2. Some
    3. Not much
    4. None

45. Which registration tasks require most of your time? Circle one:

    1. Receiving and processing applications
    2. Updating records with new or departing students
    3. Registering students

46. Are you involved in the school's materials inventory recording? Circle one:

    1. A lot
    2. Some
    3. Little
    4. None

47. Are you responsible for maintaining inventories of consumable materials for your particular classes? Circle one:

    1. Inventories required for all materials
    2. Inventories used for some materials
    3. Inventories are not used.

48. Do you use informal budgets or checklists to control students' use of materials? Circle one:

    1. For all materials
    2. For scarce materials only
    3. For non-renewable materials
    4. Don't use them

49. Do you always know what learning materials are stored in your school when you need it? Circle one:

    1. Generally yes
    2. Generally no

50. Are you aware of where to find all of the materials available:

    - within your school? Circle one:
        1. Generally yes
        2. Generally no

    - within your county? Circle one:
        1. Generally yes
        2. Generally no

51. Do you encounter any problems in obtaining or using rental texts, or with the maintenance of kits? Please elaborate.

_____

_____

_____

_____

52. To what extent do you provide career counselling to students? Circle one:

1. A lot of time
2. Moderate amount of time
3. Not much time
4. No time

53. When providing any counselling to students are you able to obtain all of the current background student information that you need? Circle one:

1. Generally yes
2. Sometimes
3. Generally no

IV. 54. Can you identify other non-teaching activities which are required to assist the teaching-learning process, e.g. text rentals, milk money. Please list these below.

Name the Task	Briefly describe the task and indicate its purpose	Time Consuming? (Indicate: 1=very 2=significant 3=somewhat 4=a little 5=insignificant)	Involves Significant Clerical Work (Indicate: 1=a lot 2=some 3=insignificant)

V. We would now like to ask you to rank the topics identified in the preceding sections in two sequences:

a) By time consumption

1 = most time consuming throughout the school year

2 = next most time consuming, etc.

b) By your desire for assistance

1 = where you would most like some assistance

2 = next most like assistance, etc.

55. Ranking

Non-Teaching Activities	Most Time Consuming	Where I Would Most Like Assistance
Test Construction	_____	_____
Assigning & Marking Tests	_____	_____
Student Grades & Reports	_____	_____
Student Attendance	_____	_____
Student Progress	_____	_____
Development of Learning Materials	_____	_____
Curriculum Design/Development	_____	_____
Inventory Control	_____	_____
Timetabling	_____	_____
Test Analysis	_____	_____
Registration/Applications/Enrollment	_____	_____
Student Counselling	_____	_____
Other (as identified in Section IV)		
_____		_____
_____		_____
_____		_____
_____		_____
_____		_____
_____		_____

VI. We would now like to explore whether or not you feel that computer technology can assist you in carrying out the identified activities.

56. Do you think that computers can be used to assist the classroom teacher? Circle one:

1. Potential for considerable use in all areas
2. Potential for considerable use in some areas
3. Little benefit to classroom teacher
4. No use

57. Do you consider that computers may restrict a teacher's freedom? Circle one:

1. Will impose too many restrictions
2. Restrictions can be overcome with proper design
3. Some restrictions may be acceptable if benefits are worthwhile

58. Do you feel that computer information may be misleading? Circle one:

1. Computer data is very open to misinterpretation
2. Qualitative information will be unreliable
3. Good system design can ensure that data is reliable

59. Do you believe that computers can assist in expanding a teacher's base of knowledge? Circle one:

1. A bank of tests, texts, special kits would be very useful
2. Some benefit
3. Marginal benefit
4. No benefit

60. Indicate the amount of training you have with respect to computers or data processing. Circle one:

1. No knowledge
2. Some informal reading
3. 1-3 formal courses of instruction
4. 3-7 formal courses of instruction
5. Over 7 formal courses of instruction

61. Indicate whether you have had direct experience in using computers. Circle the highest applicable number:

1. No experience
2. Some informal hobby experience only
3. Experience while undergoing instruction only
4. Experience in teaching students
5. Some direct experience in scientific uses
6. Significant direct experience in scientific uses
7. Some direct experience in business
8. Significant direct experience in business

ALBERTA EDUCATION
POTENTIAL AND ACTUAL COMPUTER APPLICATIONS SUGGESTED BY THE LITERATURE

A. POTENTIAL APPLICATIONS SUGGESTED BY THE LITERATURE

From our extensive review of sources of information we found few papers which described actual attempts to assist in non- teaching activities. By far the major use of computers in education appears to be still in the areas of general administration, such as payroll and accounting, and for computer assisted instruction. However, some suggestions were made for computer assistance in other areas. These included:

- Financial accounting: Teachers may use informal "budgets" at a class level to control student progress and monitor their productivity. Such a system could also provide summaries that enable the school administration to make forecasts and, on a larger scale, last year to this year comparisons could be used to predict pupil enrollment or to forecast the outcomes of proposed salary schedules.

- Inventory control: Physical resources could be controlled through inventory systems which analyze the activity of items in order to optimize their use or to set minimum and maximum stock levels. Such records could be extended for use by administrators for planning in order to discontinue resources which are not well used and increase the well used ones.

- Student records: These could be maintained centrally in order to make profiles available to teachers beyond the boundary of a single school. It seems that at present very little information follows a child to a new school, although this may be influenced by privacy legislation as well as lack of a system.

- Student scheduling: This could be optimized by constructing timetable models to identify conflicts and permit more individualization through matching skills to curriculum requirements. Such a base of data could extend ultimately to forecasting teacher and discipline demands. Furthermore, such a model can be used to optimize the allocation of students.

- Automated test scoring: This is possible when a student is given multiple choice questions. However, a teacher's ingenuity is required if such a test is to address reasoning skills instead of being merely a quiz. In addition, unless used in conjunction with computer assisted instruction, it seems somewhat counter productive.

- The school library operation can be optimized by recording book issues and receipts, printing late notices, holding books, providing lists of books by course classified as required and recommended. Furthermore, such a system could be highly useful for research by providing cross references such as a key word in context listing.

- Labour saving devices such as report card printing, maintenance of attendance records and so on may also be a benefit.

With the proper degree of integration such systems might provide important management information. For example, the distribution of students by grade could be matched to library utilization. Forecasting of student enrollment could be related to shifts within provincial boundaries in order to ensure an equitable distribution of funds. Furthermore, the integration of such systems could provide a base of student information which can be used for counselling. At least one school district in the United States uses a computer to record information which is used by professional counsellors who travel over a wide geographical area.

Although these uses have been suggested by the literature, their development remains highly experimental and few recorded cases have been found which are functional beyond the boundary of a single school.

B. APPLICATIONS CURRENTLY IN USE

The following individual applications have been found:

- Personnel uses, such as placing substitute teachers: The Detroit Board of Education uses a computer to help its 320 schools place an average of 500 substitute teachers per day. They claim a saving of $2000 per month over the previous system. To use this system, a school representative phones the computer directly between 6:00 a.m. and 9:00 a.m. if a substitute teacher is needed. He enters codes directly via touch tone telephone to identify qualifications required and other requirements. Within one second, the computer reports verbally with a phone number of a substitute teacher with the relevant qualifications.

- Student scheduling: In 1972 almost 280 schools in Ontario were using such a system provided by the Education Processing Branch of the Ontario Ministry of Education. In addition, IBM has a computer package to print student schedules. Also, Handsworth High School in North Vancouver has developed a computer program which permits variable class times to be scheduled in blocks of twenty minutes. Other systems exist in varying degrees of sophistication.

- Student records: IBM has a computer package for use within a single school. Other manufacturers also have packages which generate attendance and class summary reports.

- A "Classroom Teacher Support System" is marketed by a California company called Classroom Support Systems. The system is advertised as being capable of supporting up to 39 item banks dealing mainly with test construction and analysis of test results. The system appears to be designed for use by individual schools. This is a software package designed to run in batch mode and can be purchased for about $2500.

- A Tracking and Data Banking system called "Project Aristotle" has been developed at Humber College in Ontario to keep track of individual student progress in order to obtain student profiles quickly and to obtain statistical analyses of performance. The system is designed for college level use.

- Career Counselling: Two systems have been found.
  - "CHOICES", an interactive computer system run by Canada Manpower. This system has been tested in the Ottawa area at Sir John A. MacDonald High School, and we are told by a teacher in the school that it was very well received by students. Under a counsellor's guidance, the student answers a questionnaire before using the computer terminal. The system matches the student's qualifications to catalogued job descriptions, selects a short list of suitable careers and permits the student to compare various combinations of jobs on the short list.

  - "Student Guidance Information System", SGIS, run by the Ontario Ministry of Education. This system is more basic than CHOICES. Students complete an input document for batch processing and can receive a computer printout overnight.

- Integrated School System: run by the Ontario Ministry of Education for schools in Ontario, this system provides statistical and detailed reports of student achievement such as report cards, and also aids in compiling student history information.

- Route Modification and Update System: this system is run for school boards in Ontario by the Ontario Ministry of Education. Essentially, the system performs bus route scheduling.

ALBERTA EDUCATION
INSTRUCTIONAL SUPPORT POSSIBILITIES
IDENTIFIED FROM SCHOOL VISITS

On January 15 and 16, 1979 interviews were conducted with teachers of an elementary and secondary school in Strathcona County. Additional comments were offered by their respective principals, who were aware of and are involved with the feasibility study being conducted by our firm.

The interviews began with the consultants observing classroom activities. However, it soon became apparent that continuous classroom observation was not suitable because the support activities or non-teaching duties could not be observed during the classroom teaching-learning process. Subsequent to this brief observation, each of the selected teachers were interviewed to determine the kinds of non-teaching duties with which they are most frequently involved. An effort was made to rank these in order of their importance in terms of time and effort spent and the desirability of support from an automated system (the ranking of the teachers involved is indicated in Exhibit 1).

During the interview the following non-teaching duties were described:

1. Curriculum Design and Development - In the planning stages of the total teaching-learning process, both teachers acknowledged varying needs to design and develop curricula related to the subjects they taught. This involved a basic description of the courses and a series of statements capturing the objectives of each of the discernable units of instruction.

   It was agreed that the amount of time involved in curriculum design and development varied with the experience of the teacher, the availability of curriculum standards and pre-written objectives provided by local school boards or Province of Alberta, and the nature of the subject itself. For example, mathematics tends to be a more stable subject from the point of view of topics covered than social studies.

Although opinions varied in relation to these factors, the general conclusions reached include:

- It would be desirable if a bank of subject descriptions, outlines, and objectives could be available on a province wide basis, provided that these were not prescriptive.

- It would be especially useful to have distinct curriculum information for the same subject areas for students in need of remedial assistance, or for those achieving above average levels and who require additional or enriched learning activities.

- Curriculum information would be extremely beneficial to teachers assigned to new subjects for which previous development or curriculum standards were unavailable locally.

In the elementary system it appears that the curriculum standards prescribed by Alberta Education are closely followed. However, within those standards there are opportunities for the individual teacher to retain a degree of flexibility and to emphasize particular parts of the course. Collaboration between teaching districts appears to be somewhat informal and the amount of time spent in this exchange appears to be minimal.

2. Test Construction - In addition to a bank of course descriptions and learning objectives for each subject as described above, numerous tests have to be designed by the teacher to establish a correlation between the teaching objectives and student learning. Both of the teachers interviewed acknowledged that considerable time was spent in preparing a variety of tests in their respective subjects. Some tests are diagnostic to determine individual student abilities and to prescribe learning activities. Occasionally pre-tests and post-tests

are used. There is consensus that a data bank of tests could improve the quality of testing performed in the schools. Both teachers agreed that this topic involved a large amount of non-teaching time, and that some relief would be desirable.

3. Assigning and Marking Tests - This refers to the actual time taken to administer tests during class time and to review, mark and assign a grade to each of the applied tests. In evaluating student skills, there appears to be a higher frequency of testing throughout the school term, with the result that after test construction a great deal of time was spent in evaluating them.

Attitudes varied regarding the use of computers to relieve this onerous task. One teacher commented that it was important to review the tests manually in order to appreciate any special or significant learning difficulties experienced by an individual student. The opposite view is that the use of a computer to score such tests could enable the teacher to review and generalize the findings and still be effective in interacting with a student who appeared to be below expectations.

One of the principals indicated that recording a large number of test scores per student per term involved a significant amount of time and would be ideally suited to a computer application. This is further emphasized by the fact that these scores must subsequently be converted into a grade for report purposes.

4. Assistance in Developing Learning Materials - This refers to the actual identification and acquisition of appropriate learning materials such as printed media, audio-visual materials and simulated activities. Where the subject content is relatively stable, it is not anticipated that there would be significant change in the learning materials already being used, although there is room for occasional changes in order to introduce different ways of learning similar skills. It was agreed, however, that where subjects change or are required to keep

up with current trends (e.g. Social Studies), a continuous development of learning materials is required to meet course objectives. In this latter case it would be useful to accumulate proven materials used by teachers of the same subjects over a wider geographical region.

One of the principals commented that it would be ideal to have available a bank of core objectives and related materials for access by the teacher, and which might require only a minor amount of modification. In many cases the current lists of available materials include commercial packages which have not been tested locally by teachers, and it can be a matter of trial and error for a teacher to accept this material.

There is agreement that if the input to such a bank of data were approved by a curriculum standards committee in the County, it could attain a degree of quality and could offer reasonable assurance that the materials were usable in their existing form. It was also indicated that access to such information could quite reasonably consist of a single page abstract containing a brief description of the material and its application. In addition, the names of the schools and teachers in the region who had experience with the material would provide a useful reference.

5. Test Analysis - This term refers to the analysis of test results by teachers to identify whether parts of a subject require a revised teaching methodology, or as a general check on the validity of the tests themselves or to provide some analysis of the skills tested in relation to objectives. Because of all of the other demands on a teacher's time, it was agreed that test analysis was not a high priority item. However, it was regarded as an ideally suitable one for program, subject and teaching evaluation. This analysis also offers opportunities to comment on the performance of a class as a whole, or of each student. In the latter case, the analysis acts as an opportunity for developing a particular learning prescription.

6. Student [illegible]s (Tracking) - This concept is especially useful where instruct[illegible] is predominantly individualized. In a modular or unitized approach where students progress at their own pace, the weekly or monthly tracking of student performance is useful. It would enable a teacher to:

- Determine the number of students in each unit at a specific time;
- The number of days students spent in each skill area per unit;
- The percentage of students who passed both pre- and post-tests;
- Whether students maintained the required schedule;
- Whether students would complete the remaining units on time.

Individualized instruction was not a formal mode of instruction in either of the schools visited, but the need to maintain accurate student progress records was regarded by both teachers to be essential. Both teachers maintained their own manual records of a number of tests and assignments, their results, and personal observations about each of the students. This is a high "time consumption" activity.

7. Student Grades and Reports - This term generally refers to the conversion of the assignment and test evaluations into term grades and subsequently into individual reports. The conclusion reached here is that the bulk of the work is involved in the actual marking of assignments and tests, and that compiling reports represents the lower portion of time required to complete the entire cycle of report generation. To the extent that there are a number of calculations of student averages and final grades this could be relieved by computerization.

8. Student Attendance - This refers to the requirement of the teacher to maintain accurate attendance records of all students as prescribed by school policy. In each case studied there was a requirement to

maintain day by day records of student attendance and to submit them to the school administration on special forms either weekly or monthly. This was not considered to involve a great deal of time and effort. However, the use of a computer printout which had been entered and edited by the teacher in question could be of value to attendance counsellors in their follow-up work on student absenteeism.

9. Timetabling - This is normally administered by non-teaching staff and monitored by vice-principals or principals. In the two schools surveyed it did not consume much time as far as the classroom teacher is concerned although the load on teachers varies by the size of school, e.g. in smaller schools it involves more of the teacher's time. There may be occasions when students have selected courses at conflicting times and the teacher, based on prior knowledge of the students abilities, makes recommendations to have the individual timetable changed.

10. Registration - Applications - Enrollment - It is important to the school for reporting purposes and for obtaining grants to maintain accurate records of student enrollments. This includes information on new and departing students. Identifying the last place of study of the students currently enrolled indicates the anticipated share of students from the elementary schools for capital planning. While this is not a major time constraint for teachers it apparently causes the non-teaching administrative staff considerable amount of effort at peak periods of the year because of manual recording and the duplication of reports required.

11. Inventory Control - Because of the subject taught there may be occasions when individual teachers have assigned to them an inventory of resource materials or teaching equipment. This did not appear to be an onerous task, although it seems to have obvious implications in school libraries or learning resource centres of a regional nature.

12. Student Counselling - This could involve either educational, career, or personal counselling and requires access to a large amount of biographical and academic information about each of the students. Especially so, where most of the counselling is done by a teacher with his or her own students. There are usually sufficient manual records available for adequate counselling. Where there are staff members assigned full time to this activity, they are in need of more comprehensive data of all students. This is especially important in the event that students are transferred in from other school jurisdictions and historical information is not currently available. It was noted that such records are open to misinterpretation or abuse, and that proper controls would be necessary in view of the possible effect of wrong information on a student's future.

These are the non-teaching activities which were identified in two days of personal interviews. Exhibit 1 indicates the priorities assigned to these non-teaching activities by the teachers interviewed in terms of the degree to which they permit a teacher to spend more time on the teaching-learning activities.

A number of potential computer applications are possible in the list of non-teaching activities which have been described. However, before any conclusions can be reached regarding the feasibility of using a computer, it is necessary to confirm these preliminary findings with a larger sample of interviews or the use of a standard questionnaire. Exhibit 1 for example, does show a high correlation of the perceived priorities relative to test construction, administration, marking, recording and analysis. Furthermore, in our view, developing a satisfactory repertoire of teaching objectives, activities and materials would seem to be an additional area where computerization is potentially helpful.

APPENDIX V
Exhibit 1

RANKING OF NON-TEACHING ACTIVITIES
IN TERMS OF TIME AND EFFORT INVOLVED
AND DESIRED SUPPORT SYSTEMS

ITEMS	NON-TEACHING ACTIVITIES	RANKING#1	RANKING #2
1.	Test Construction	1	3
2.	Assigning and Marking Tests	2	1
3.	Student Grades and Reports	3	8
4.	Student Attendance	7	9
5.	Student Progress	5	2
6.	Development of Learning Materials	5	5
7.	Curriculum Design/Development	6	7
8.	Inventory Control	8	6
9.	Timetabling	9	N/A
10.	Test Analysis	4	4
11.	Registration - Application - Enrollment	10	N/A

Note:
- The rankings should not be expected to show any significant correlation in view of differences in the levels of education - elementary and senior secondary, and the subjects taught - social science and mathematics. Of note, however, is the perceived importance, in the first 5 choices of both teachers, attached to the time-consuming areas of test construction, assignment marking, grading, analysis, and tracking of student progress.

- These activities have been ranked from a teacher's viewpoint. If the school administration were considered, then registration and enrollment, timetabling, inventory control and student records would probably have ranked higher.

ALBERTA EDUCATION
SUMMARY OF QUESTIONNAIRE RESPONSES

Approximately 2000 questionnaires were distributed to teachers in 140 schools. About half, or 1029, were returned to us. However, very few teachers answered all questions and the accuracy of the results outlined below must therefore be considered somewhat less than is implied by the assignment of numerical values.

After reviewing the responses, we concluded that it was valid to extract the following information:

- Ranking of the twelve non-teaching tasks in question 55 in terms of where teachers would welcome some assistance (Exhibit 1).

- Ranking of the kind of testing performed, as discussed in question 18 (Exhibit 2).

- Key comments extracted from the responses (Exhibit 3).

The results were surprisingly uniform in all categories. One might speculate that this is because teachers had not really considered CBIS before, or that since the questionnaires were completed in the last week before the summer break, many of the tasks addressed by CBIS had lost their immediacy. Whatever the reason, we have combined the results into the groupings that appear meaningful.

ALBERTA EDUCATION

NON-TEACHING TASKS RANKED IN ORDER OF TIME CONSUMPTION

Task		Rank	Percent Response
Test Construction Development of Learning Materials	(1)	1	consistently over 70%
Assigning & Marking Tests Student Progress (Tracking) Test Analysis	(2)	2	consistently over 20%
Student Grades & Reports		*	
Student Attendance		*	
Curriculum Design/Development		*	
Inventory Control	(3)	*	about 3% of the total response
Timet[illegible]ng		*	
Regist[illegible]ion-Application-Enrollment		*	
Counselling		*	

Notes:
1. These two tasks were overwhelmingly chosen first. Sometimes they changed places but by only marginal differences in ranking.
2. These three tasks were also rated almost equal to each other but well below the first two.
3. The response to these questions was generally too low for significant ranking, often no response was given.

ALBERTA EDUCATION

TYPES OF TESTING MOST COMMONLY PERFORMED

Test Objective	Rank
Knowledge	1
General Achievement	2
Comprehension	3
Diagnostic	4
Application	5
Attitudes	6

Note: Testing for knowledge and general achievement received about two-thirds of all responses. The most common reason for concentrating on these was the amount of time needed to construct tests and interpret the results.

ALBERTA EDUCATION

COMMENTS EXTRACTED FROM TEACHER QUESTIONNAIRES

In addition to multiple choice questions, the questionnaire also invited written comments. Samples of the more common comments are listed below.

- Would like to reduce the amount of time involved in test construction and text rental.

- There is a lack of options within the structure of the existing curricula. Kits are readily available but test construction requires a lot of time. With more time to prepare tests, the thoroughness of tests could be better evaluated.

- Difficult to ensure equal difficulty of tests for equal marks. Testing methods could be improved with a more detailed item bank.

- New social studies curriculum is not specific enough as to how to cover topics. Very open for interpretation and concepts which are not at the student's comprehension level. More time is needed for test construction, test analysis. A question bank for test construction would be desirable. The availability of rental texts and kits can be a problem.

- Grade 1 is often judged by daily work - not tests.

- No curricula are available for special education in language programs at Grade 10 level with students' ages 15 to 17. Special education implies a wider than normal range of student skills, which in turn means that any given test is not fair to some students. The burden of test construction is therefore greater than for normal classes. Multiple choice tests are not valid for special education, which requires more individual tailoring.

- More time is needed for curriculum design and test construction. Access to up-to-date outside references would be useful, s would money for equipment. It is difficult to equalize the difficulty of tests between classes and semesters. Regarding testing methods, would like more variety of questions with similar degrees of difficulty. Science has special testing needs in that lab work must be evaluated.

- Test construction: obtaining a good balance between primary recall questions, first level application and more integrated application questions is difficult.

- Test construction: it is difficult to test different skills on one exam, such as recall and applied knowledge. Tests should let students think by applying what has been learned. This teacher teaches English and never gives multiple choice examinations.

- More time for test construction required as well as contacts to cover for skills which the teacher doesn't have. Preparing for lessons is a new task not identified in our preliminary task list.
- The new curriculum is too loosely structured.
- It is difficult to make multiple choice questions for social studies.
- For technical vocational training computers are of no use.
- Teaching French as a second language, it is difficult to find tests for advanced students. It is also difficult to ascertain if original course objectives have been met and tested for.
- Curriculum design: it is difficult to incorporate a practical design for non-academic students.
- It is difficult to test the student's abilities in horticulture, and computer would be of no use.
- It is difficult to construct tests which enable students to think rather than just recall.
- In teaching performing arts, lab preparation requires the teachers to evaluate theatres and equipment. The teacher would also like to enhance his individual (teacher) study. It is difficult to find adequate classifications of theatre history. A more complex multiple choice test scheme would be possible if a computer could assist in scoring.
- Curriculum development: it is difficult to decide whether students can learn enough for a profession or career.
- Test construction: increased variety of questions.
- Test construction: testing attitudes and diagnostic tests for specific applications is too difficult and time consuming for the ordinary teacher. More remedial and counselling personnel are required. Curriculum design: the present Grade 7 design implies a knowledge that students haven't got. The present functional design of science courses leads to piecemeal rather than integrated knowledge. Functional design implies for example, that in studying science, students will study nutrition and digestion in selected organisms rather than concentrating on one particular organism. (Note: CC&L can't comment on education approach but a system could be developed to match actual results to intentions.)
- It would be desirable to relate curriculum changes to the required teacher training and materials needed before actually making the changes. In test construction, it is difficult to find material that is current and with wording that is clear and concise, especially for provincial finals. More frequent diagnostic tests are needed but impractical at present because of the time required to prepare them.

- Individual student programs are difficult to maintain as the time available is difficult to find.

- Kits and texts rentals are difficult because many are booked early in the school year. There is a need for more availability.

- Test construction is difficult with students with disabilities in sight, hearing, learning, etc.

- It is desirable to test more efficiently by constructing shorter tests which still cover course objectives.

ALBERTA EDUCATION
POSSIBLE HARDWARE CONFIGURATIONS FOR CBIS

Several hardware configurations are capable of satisfying the CBIS requirements defined in the report and are described below. In practice combinations of these may be appropriate in different areas of the Province. First of all, let us consider the data volumes which may be involved. In estimating the volumes, we have made the following assumptions:

- Alberta has 500,000 students and 20,000 teachers in schools, with a maximum of 2,500 students and 100 teachers in any one school.

- A student's computer record requires 1,000 characters, references require 200 characters.

- References will be stored for an average of 3 years.

In a study of this nature it is possible to consider only broad estimated values and the estimates below are mainly useful for obtaining a total volume estimate. The totals obtained are comfortably within current technological limits.

- Student Records:

  500,000 students x 1000 characters each of active records
  = 500 million characters
  Maximum for one school: 2500 students x 1000 characters
  = 2.5 million characters
  Average school: 500 students x 1000 characters
  = 500,000 characters

- Learning Aid References:

20,000 teachers x 100 active references each x 200 characters
= 400 million characters
Maximum for one school: 100 teachers x 100 references x
200 characters = 2 million characters
Average school: 25 teachers x 100 references x 200 characters
= 500,000 characters

- Test Item Bank

Assume that an average test uses two typewritten pages, each of which contains an average of 30 lines. A line on a letter-size page contains an average of ten words of five letters each. In other words, an average test will contain:

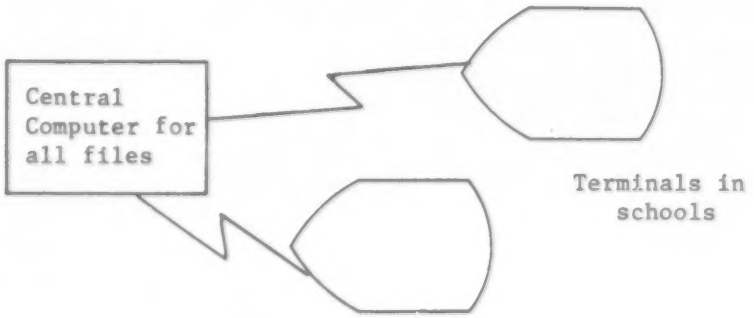
2 pages x 30 lines x 10 words x 5 letter = 3000 characters

Therefore, the volumes involved would be:

20,000 teachers x 100 references x 3000 characters
= 6 billion characters

We have assumed that references will be made by individual teachers and remain active for about three years. This is the basis for our assumption of 100 references per teacher. Now we will describe the various possible hardware combinations.

A. CENTRALIZED CONFIGURATION



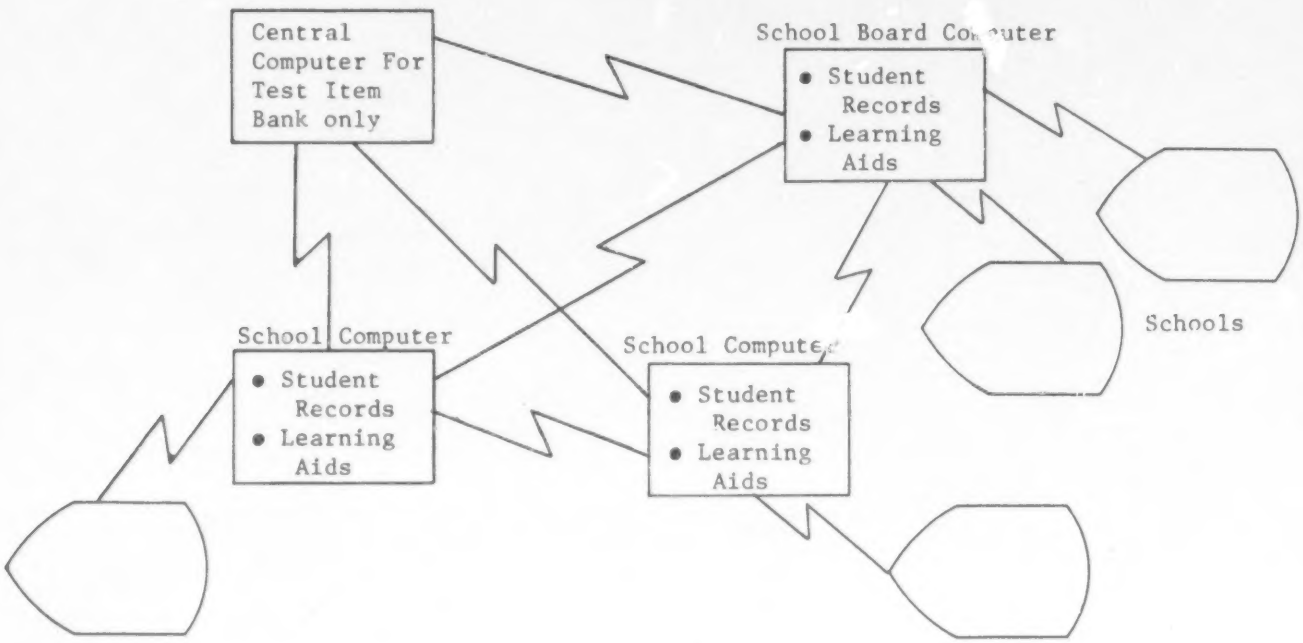
This arrangement would require a central computer capable of handling 1.3 billion characters of file space if test references are stored, or 6.9 billion characters if actual tests are stored. Each school would require at least one terminal, making a current minimum requirement for 1400 terminals throughout the Province.

After talking with two major computer manufacturers, an estimated minimum hardware cost for such a system would be:

Central computer:	$1 million to $2 million
1400 terminals at about $2000:	$2.8 million
TOTAL	$3.8 million to $4.8 million

In addition, telecommunications costs would be involved between terminals and the central computer.

B. PARTIALLY DECENTRALIZED APPROACH



In this arrangement, a central computer contains a test item bank only. Larger schools or school boards have their own computers for local files.

Storage requirements for this system would be:

- Central computer: 800 million or 6 billion characters depending on whether test item references or actual tests are stored.

- Maximum school storage: 4.5 million characters for student records and learning aid references.

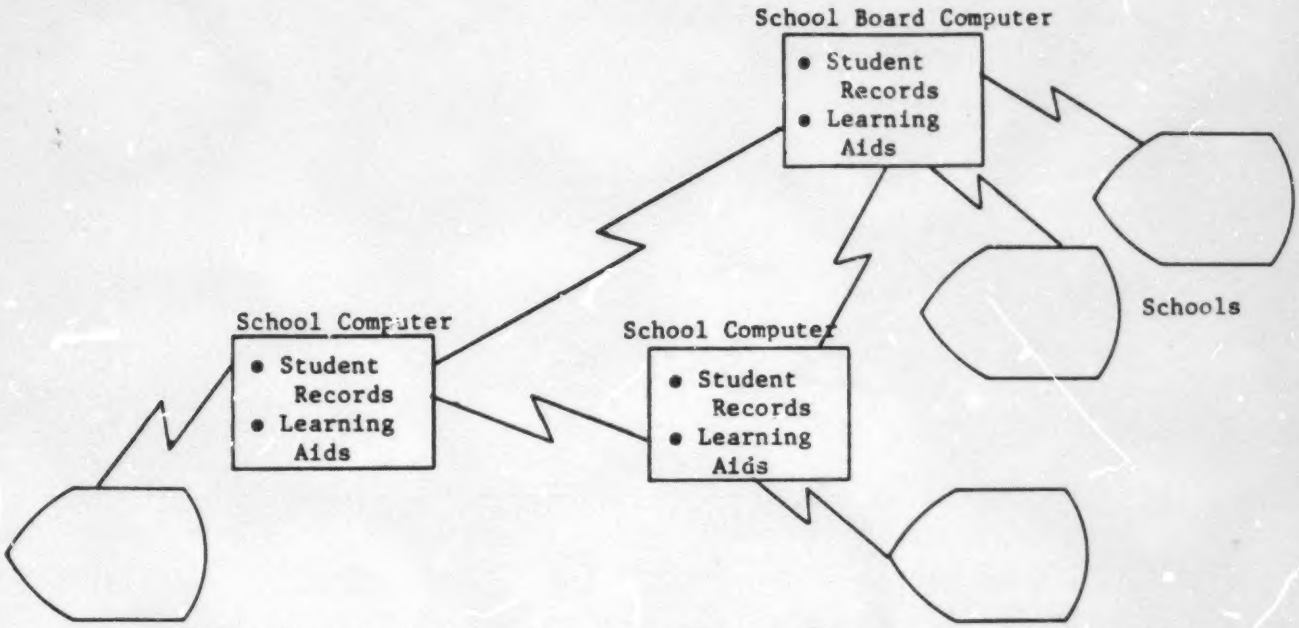
- Average school storage: 1 million characters for student records and learning aid references.

Without analyzing the schools it is impossible to estimate a total cost because the mix of hardware is unknown. However, this hardware configuration would be significantly more expensive than the centralized option since the central computer would still be about the same size and, in addition, there would be smaller computers at various locations at a cost of $35,000 to $80,000 each. In the annual report issued by the Department for 1977-78, there were 193 school boards listed. If half of these, or 100, require computers at an average cost of $50,000 each, then an additional cost of $5 million for hardware is involved. Thus the total minimum cost for hardware is as follows:

Central Computer:	$1.0 million to $2.0 million
1400 Terminals at $2000:	2.8 million
100 small computers:	5 million
TOTAL	$8.8 million to $9.8 million

This would, of course, be reduced by the amount of suitable hardware already installed thoughout the Province.

C. TOTALLY DECENTRALIZED APPROACH (WITH AMENDED CBIS)



This arrangement provides for student profiles and a bank of learning aid references at the individual school or school board level. There is no central computer and hence no test item bank.

The cost of this alternative is very difficult to estimate because, without analyzing each school in the Province, it is impossible to determine how many computers would be involved. However, for estimating purposes, we will assume that one terminal per school is minimum and that about 100 school boards will require computers, as in the previous alternative. The minimum cost for this alternative would therefore be:

1400 terminals at $2000:	$2.8 million
100 small computers at $50,000:	$5.0 million
TOTAL	$7.8 million

This would be reduced by the amount of suitable hardware already installed. The significant cost advantage with this alternative compared to that outlined in section B is that there is no need to establish a large central data centre.

There are obviously many intermediate configurations between these three examples, but the centralized alternative represents the minimum hardware cost version. For CBIS, the Department can therefore expect entry-level purchase costs for hardware alone of about $5 million to $10 million, or around $100,000 per month as estimated by one vendor.

ALBERTA EDUCATION

COMPARISON OF THE POSSIBLE HARDWARE CONFIGURATION

In Appendix VI we identified the range of computer hardware alternatives which can support CBIS as defined in the attached report. Here, we compare the hardware examples from the viewpoints of cost, development, implementation, and operation. Organizational aspects will also be considered.

Centralized (Alternative A in Appendix VII)	Partially Decentralized (Alternative B in Appendix VII)	Totally Decentralized (With Amended CBIS) (Alternative C in Appendix VII)
A. HARDWARE COST		
• $5 million minimum plus large telecommunications usage	• $10 million minimum plus smaller telecommunications usage	• $8 million minimum plus smallest telecommunications usage
• Large initial outlay for central computer. The risk is therefore high in terms of money lost for failure	• Expenditure can be phased through staged implementation. Lower risk of money lost	• Expenditure can be justified by individual school boards, and can be phased.
• Funding by Alberta Education or through a cost-sharing formula with school boards	• Funding could be handled by school boards except for the centralized portion of the system	• Funding could be handled by school boards except for a centralized policy and technical support group

Centralized (Alternative A in Appendix VII)	Partially Decentralized (Alternative B in Appendix VII)	Totally Decentralized (With Amended CBIS) (Alternative C in Appendix VII)
B. DEVELOPMENT AND DESIGN		
• Requires a central body to administer the central computer. This would be expected to involve considerable negotiations with school boards to resolve questions relating to funding, jurisdiction, responsibilities and local autonomy. This should be resolved before proceeding with any system development.	• The centralized portion of this alternative requires the same effort as noted opposite. However, concurrent implementation of local systems could be undertaken. The minimum delay here would be to establish rules under which local systems could proceed.	• Concurrent implementation of local systems could be undertaken. Minimum delay would be to establish rules under which local systems could proceed
i.e. long start-up time	i.e. much faster start-up possible	i.e. fastest start-up possible since there is no centralized portion to accommodate
• Requires data base designers with outstanding credentials	• Requires data base designers with outstanding credentials	• Requires data base designers with outstanding credentials
• Good security needed for central student files	• Security problems less severe since student records are stored locally	• Security problems less severe since student records are stored locally
• Not very suitable if schools want to do CAI or accounting on same computer	• Easier for schools to share local computers with CAI or accounting	• Easier for schools to share local computers with CAI or accounting
• Less responsive to the needs of individual schools since all schools use the same programs	• More opportunity to vary programs with local needs	• More opportunity to vary programs with local needs

Centralized (Alternative A in Appendix VII)	Decentralized (Alternative B in Appendix VII)	Totally Decentralized (With Amended CBIS) (Alternative C in Appendix VII)
B. DEVELOPMENT AND DESIGN (Cont'd)		
• Easier to monitor and enforce good practices and disciplines for computer use and system development	• Difficult to monitor the multiple uses to which a school may put its own computer	• Difficult to monitor the multiple uses to which a school may put its own computer
• More difficult for schools to "opt out", which would erode the benefits of CBIS	• Easier for schools to "opt out" and maintain their own reference bank, while still using others in the central system or on other computers	• Easier for schools to break from central standards; i.e. could deteriorate into individual computer systems which would result in an expensive method of keeping student records only
• Easier to provide technical support	• More difficult to resolve technical problems that may be caused locally	• More difficult to resolve technical problems that may be caused locally
C. IMPLEMENTATION		
• No real difference as far as schools are concerned	• No real difference as far as schools are concerned	• No real difference as far as schools are concerned
• Central group involved in all school implementations	• Lesser involvement of central group	• Central group is advisory only, except for enforcing data discipline
D. OPERATION		
• Easier to monitor data and processing integrity	• More difficult to enforce file integrity since programs are stored locally	• More difficult to enforce file integrity since programs are stored locally

Centralized (Alternative A in Appendix VII)	Decentralized (Alternative B in Appendix VII)	Totally Decentralized (With Amended CBIS) (Alternative C in Appendix VII)
D. OPERATION (Cont'd)		
• Standards of operation and file backup can be rigidly enforced	• Less control over quality of system operation.	• Less control over quality of system operation.
• More critical performance of computer system is required since downtime affects all users.	• More tolerance since one computer down does not affect other users.	• More tolerance since one computer down does not affect other users.